Risk Control Bulletin

Inert Gas—Shielded Arc Welding

RISK CONTROL

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General

Inert gas-shielded arc welding is a special form of arc welding. An electronic arc is struck between the electrode (cathode) in the torch and the metal work piece (anode), and a flow of inert gas (or gas mixture) provides a shield to protect the molten metal from contact with air. Either a consumable electrode as an uncoated metal rod or wire is used which melts and fills in the weld or a non-consumable tungsten or thoriated tungsten electrode is used which conducts the current and is supplied with metal for the weld or coating from the second rod, or a metal power fed through the torch. This type of welding is used primarily with aluminum, stainless steel or copper. It is also used in welding steel parts if oxide scale around these welds would interfere with further processing, such as painting, plating, or machining.

Hazards

Radiation

The high temperatures developed during this type of arc welding ionize the gases and metal vapors producing intense ultraviolet, visible, and infrared radiation. The wavelengths of the UV radiation produced depend on the type of gas shield and the metal heated. The shorter wavelengths are considered more hazardous. The amount of ultraviolet radiation produced with an argon gas shield is greater than from a helium gas shield. The intensity is reportedly greater with consumable electrodes than when the tungsten electrode is employed. Aluminum welding is said to produce the most intense short ultraviolet radiation.

Fumes

At the high rates of welding possible with this technique, considerable amounts of metal may be volatized. Excessive concentrations of aluminum oxide fume are readily produced by inert gas welding in the absence of effective ventilation. Fumes from stainless steel welding may contain nickel and chromium, which are considered more harmful than iron and aluminum. Metal fume fever from copper welding has been observed. The use of aluminum welding rods containing traces of beryllium has been reported not to give rise to harmful amounts of beryllium oxide fumes. Aluminum alloys containing 5 percent silicon, however, may produce significant silica fume concentrations. No significant quantities of radioactive fumes were obtained from the use of thoriated tungsten electrodes. Moreover, the absence of welding rod coatings eliminates one source of undesirable fume, particularly of fluorides, which are often found in coatings for aluminum and stainless steel welding.

Gases

Ozone is produced in significant amounts especially in the welding of aluminum by ultraviolet radiation (below 200 nanometers wavelength) acting on oxygen in the air. The amount of ozone produced depends directly on the intensity of the ultraviolet radiation. Since the radiation can pass through the air, ozone can be formed several feet from the arc as well as at the arc.

Oxides of nitrogen ("nitrous fumes") from the high-temperature combination of oxygen and nitrogen in the air are formed in limited amounts at the arc but are diluted rapidly by air movement.

Welding inside an unventilated enclosure may permit the gases to produce a hazardous concentration. Irritant and toxic gases, including phosgene, are the decomposition products resulting from the action of ultraviolet radiation on the vapors of chlorinated hydrocarbon solvents, such as trichloroethylene and perchloroethylene. The chlorinated vapors may arise from degreasing operations nearby or from the degreasing of the metal prior to striking the arc.

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Effect of Shield Gas

The shielding gases may be argon, helium and for special applications, nitrogen. Carbon dioxide, although not an inert gas, is finding increased use in the welding of carbon steels. The intensity of ultraviolet radiation and the rate of formation of ozone and (in the presence of trichloroethylene) phosgene are higher with argon than when helium is used. Carbon dioxide is dissociated by the heat of the arc to form carbon monoxide. While the total amount of carbon monoxide detected in a well ventilated area is small, a relatively high concentration of carbon monoxide may be excessive.

Protective Measures

Radiation

The eyes and skin require protection from the intense radiation produced by the inert gas-shielded arc. Welding helmets should be worn by the operator and other persons in the direct path of radiation from the arc. Protective goggles or spectacles should be worn under the helmet to protect against stray flashes and reflected ultraviolet light. The shades of filter plates for welding helmets depend on current ranges, i.e., – 5 to 75 amps – plate shade Number 5 to 9; 75 to 200 amps – plate shade Number 10; 200 to 400 amps – plate shade Number 14.
All parts of the body which could be exposed to the ultraviolet and infrared radiation should be kept covered to protect against skin burns. Dark wool clothing, particularly a dark shirt, will reduce reflection to the welder's face underneath the helmet.

All gas-shielded arc welding operations should be effectively screened from other workers.

Fumes and Gases

Inert gas-shielded arc welding should not be performed in a room containing chlorinated hydrocarbon solvent degreasers or other sources of such vapors. Local exhaust should be provided for any enclosed or partially confined operation and particularly when welding on metals which may generate toxic fumes. Local exhaust ventilation is recommended for the removal of oxides of nitrogen and small quantities of ozone. Where high concentrations of ozone are produced, as may occur in the welding of aluminum, a ventilated booth may be desirable. Airline respirators or respirators approved by NIOSH for protection against the inhalation of toxic fumes may be employed if ventilation is impracticable. If respiratory protective equipment is used it must be as part of a complete respiratory protective equipment use program as required by the Occupational Safety & Health Administration (OSHA).

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Date	Company Name	
Project Number/Name	Meeting Location	Person Conducting Meeting

Items Discussed

Problem Areas or Concerns

Attendees

Comments